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(71) Applicant *(for all designated States except US)*: **SVEDALA BARMAC LIMITED** [NZ/NZ]; Mangawhero Road, Matamata (NZ).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **KENNEWELL, Neville, Hugh** [AU/AU]; Chartley Street, Warners Bay, NWS 2282 (AU). **COUNSELL, Phillip** [NZ/NZ]; 20 Tahawai Crescent, Matamata (NZ).

(74) Agents: CALHOUN, Douglas, C. et al.; AJ PARK, Intellectual Property Lawyers and Patent Attorneys of Huddart Parker Building, 1 Post Office Square, Wellington (NZ).

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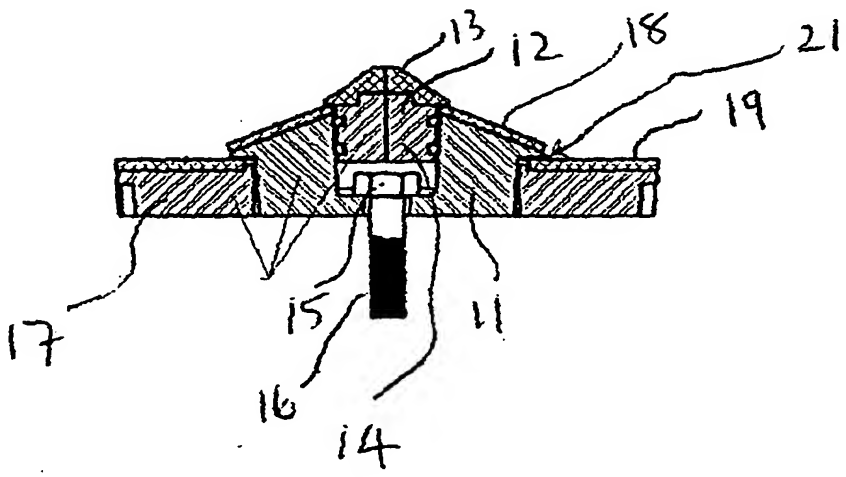
(54) Title: ROTARY MINERAL BREAKER DISTRIBUTOR PLATES



(57) Abstract: A rotary mineral breaker of the type having a distributor assembly of a rotor able to rotate about a substantially vertical axis to receive under gravity axially mineral pieces. The rotor comprises a first component and a second component. The first component at least in part is steeper with respect to the horizontal surface of the second component resulting in an overall mineral distributing surface contour about the rotor.

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"ROTARY MINERAL BREAKER DISTRIBUTOR PLATES"

TECHNICAL BACKGROUND

The present invention relates to components and assemblies incorporated in or to be incorporated in a mineral breaker, such as for example, that typified by the BARMAC™ brand rotary mineral breakers such as disclosed variously in US Patent 4,662,571 and 4,586,663, New Zealand Patent 250027, PCT/NZ97/00108, PCT/NZ98/00076 and PCT/NZ98/00075.

The present invention also relates to methods of fabrication of components and the resulting assemblies suitable for such machines or as replacement parts for such machines.

BACKGROUND ART

In the BARMAC™ type mineral breaker (eg; of US Patent 4,662,571) a rotor receives under gravity a substantially axial flow of mineral pieces to be further diminished in size. These pieces are thrown radially from the rotor after transiting a bed of rotor retained mineral pieces. Such thrown pieces impinge on a surrounding bed of earlier thrown mineral pieces thereby, by mineral piece to mineral piece interactions, providing the diminution of particle size. The particles of reduced size eventually fall from the machine.

A feature of the device is the wish to minimise wear. It is for this reason, where possible, as many interactions as possible are between mineral pieces with as few as possible being on non-sacrificial readily replaceable surfaces forming part of the machine itself. Where it is necessary to allow contact and thus wear there is preferably some enhancement of wear surfaces by the use of appropriate materials (such as tungsten carbide as the sacrificial surface of otherwise steel wear plates and for the otherwise steel distributor plate surface) although hard steel alloys such as high chrome alloys have been used in the past without enhancement (eg; a full covering with tungsten carbide) for backing plates.

As shown herein in Figures 1A and 1B there is BARMAC™ type machine (such as disclosed in PCT/NZ98/00076) which utilises a distributor plate designated as 'A' in the aforementioned Figures 1A and 1B. Whilst such a distributor plate may be flat

it may also be conical, dome-like or of some other appropriate three dimensional surface shape. Such a distributor plate is difficult to manufacture for larger sizes where there has been used a steel or the like low cost substrate to which is adhered or otherwise fixed a shaped piece or multiple pieces of an appropriate hard yet sacrificial material, e.g. tungsten carbide.

DISCLOSURE OF THE INVENTION

Whilst constructions have previously been considered where "petals" of tungsten carbide material are adhered to substantially conform to the underlying substrate steel surface contour the positioning and retention of the petals of tungsten carbide have been difficult to achieve. Such difficulties have been greater with larger diameter distributor plates.

The present invention is directed to components of a distributor plate and/or the assemblies thus fabricated.

In a first aspect the present invention consists in **a distributor assembly of the rotor of a rotary mineral breaker**, said rotor being of a kind adapted to receive under gravity substantially axially of the rotor mineral pieces to be broken and at least initiate the outward flow of such mineral pieces, said distributor assembly defining, with a first component, a wear resistant surface at least adjacent and about the rotor axis to receive in use at least some of said mineral pieces under gravity, and, with a second component, a wear resistant surface peripherally about at least said wear resistant surface of said first component,

wherein said first component defines a wear resistant surface that at least in part is steeper with respect to the horizontal than the wear resistant surface of said second component.

Preferably said wear resistant surface is of a material affixed to and/or embedded in a substrate of that same component.

Preferably said wear resistant surface is defined by an appropriate carbide.

Preferably said second component defines a wear resistant surface greater in area when viewed in horizontal plan than the corresponding area of the wear resistant surface of said first component when also viewed in horizontal plan.

Preferably at least part of said second component underlies and is captured in use

to said rotor by said first component.

Preferably fixing means locates said first component relative to the rotor and in use such location of the first component locates said second component.

Preferably said fixing means of said first component relative to the rotor is a rotor axis aligned bolt that engages into or through the rotor base.

Preferably said first component at least in part overlies part of said second component and at least in part is positioned within said second component so as to be capable of locating said second component between said first component and the rotor base so as to present a wear resistant surface of said second component about a wear resistant surface of said first component.

Preferably said second component is capable of being rotated about the rotor axis without removal of said first component to thereby present different zones of the wear resistant surface of said second component as zones of preferential wear in use.

Preferably said fixing means is a bolt at the rotor axis engaged into or through the rotor base and the head of said bolt is in turn protected by a cap substantially centrally positioned with respect to said first component.

Preferably said cap is provided with a wear resistant surface and is at least in part received within a recess centrally of said first component above the head of said bolt.

Preferably there is in addition at least one further component itself defining a wear resistant surface to be positioned more peripherally than the wear resistant surface of said second component, at least one of said first or second components directly or indirectly providing a capturing or location effect with respect to the rotor of the additional component or components.

Preferably the wear resistant surface of said second component is of substantially a simple horizontal annulus or a shallow rise frustoconical variant of such an annulus.

Preferably said first component is substantially of conical (which includes frustoconical), dome or bell shape in nature.

Preferably said wear resistant surface of said first component is symmetrical about the axis of the rotor.

In another aspect the invention is **a first component** for a distributor assembly as previously defined.

In another aspect the invention is **a second component** for a distributor assembly as previously defined.

In another aspect the present invention consists **in or for a rotary mineral breaker, a multi-tiered distributor plate** being a composite of at least

a first component in the rotor or capable of being positioned in the rotor so as to be surrounded at least in part by a second component, and

a said second component,

the arrangement being such that in use said first component assists in locating a mineral contacting part of said second component about the rotor axis.

Preferably said second component defines an annular or the like region about a central region, the central region being defined at least in part by said first component.

Preferably said first and second components is fabricated so as to be provided with a wear resistant surface.

Preferably said first component at least in part overlies said second component.

Preferably the apparatus in rotor of a rotary mineral breaker provides or will provide an assembly of the present invention as previously defined.

In yet another aspect the present invention consists in **a distributor plate** for a rotary mineral breaker comprising or including

a first component capable of being positioned at least in part over and at least in part within a second component, and

a said second component, the two components being capable in a rotor of defining a compound mineral distributing surface contour over at least part of the base of the rotor.

Preferably said first component is capable of being fixed to the rotor at the rotor axis.

Preferably each such component has been formed of a substrate material carrying a wear resistant material such that, in use, such wear resistant material defines said mineral distributing surface contour.

Preferably when in use the rotor of a rotary mineral breaker provides or will provide an assembly of the present invention as previously defined.

Preferably each of said first and second components has at least part of the

surface thereof to forming or to form part of said compound mineral distributing surface contour defined by an appropriate sacrificial material.

Preferably said appropriate sacrificial material is a carbide.

Preferably said appropriate carbide is tungsten carbide.

In another aspect the present invention consists of **a method of providing a compound mineral distributing surface contour in the base of the rotor of a rotary mineral breaker**, said method comprising or including

assembling by pre-assembly or sequential positioning within said rotor a first and second component of a kind as previously defined (if sequentially positioned, said second component being placed first), and

thereafter attaching said first component to the rotor so as to capture both said second component and said first component to the rotor base.

In another aspect the present invention consists **in or for a rotary mineral breaker, a composite distributor plate** being an assembly of two or more members, each of which members has a carbide wear resistant surface.

Preferably the base of the rotor of such apparatus by one of said members only, at least one other such member being rotatably captured to the rotor by that member fixed to said rotor base.

In another aspect the invention is any mineral deflector or distribution component of or for a rotor of a rotary mineral breaker, said component being substantially of a kind herein described with reference to any one or more of the accompanying drawings and which forms or is to form part only of a mineral distributing surface of such a rotor over or as part of the base thereof.

To those skilled in the art to which the invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the scope of the invention as defined in the appended claims. The disclosures and the descriptions herein are purely illustrative and are not intended to be in any sense limiting.

DETAILED DESCRIPTION OF THE INVENTION

Preferred forms of the present invention will now be described with reference to the accompanying drawings in which;

Figure 1A is a perspective cutaway diagram of a BARMAC™ type machine as previously defined by way of reference, the letter "A" indicating the distributor plate,

Figure 1B is an enlarged view of the rotor in a machine of the kind shown in Figure 1A showing the disposition of the distributor plate "A" with respect to a retained bed of mineral pieces supported by the rotor between a wear plate at the exit port from which the migrating mineral pieces are thrown as well as a shaping plate at the back of the bed,

Figure 2 shows an assembly which substitutes for distributor plate "A" in such a machine as depicted in Figures 1A and 1B,

Figure 3A shows the first member of an assembly as shown in Figure 2, the first member having a substantially annular contoured surface of a wear resistant material such as tungsten carbide over the substrate steel or other support,

Figure 3B shows the second member which is substantially frustoconcial or dome shaped and has a corresponding wear resistance surface (eg; of tungsten carbide) and which second member is capable of being centrally placed over the member shown in Figure 3A and held together by appropriate means as shown in Figures 2, 4 and 5,

Figure 4 is a perspective view from above of the arrangement as shown in Figure 2,

Figure 5 is a transparent side elevation showing the assembly of the Figures 2 and 4,

Figure 6 is a plan view of a preferred distributor assembly of a rotor showing an annulus of the second component exposed beyond a partial overlaid zone of the frustoconical first member, such first member being held in place to the rotor base (not shown) by a bolt the head of which is capped by the receiving of an appropriate capping member within a central recess of said first component,

Figure 7 is a section of the assembly of Figure 6, and

Figure 8 is an exploded view of the assembly of Figures 6 and 7 showing how if desired notches in the substrate of the second member can be used to relocate sacrificial areas being typical areas of high wear corresponding to the number of exit ports on the rotor (in the case of Figures 6 to 8 - three exit ports), such incremental rotation regularly ensuring a maximum use of the sacrificial impact/wear resistant

carbide surfacing of said second component.

The present invention relates to multi-tiered distributor plates (eg; two, three or more tiers) but hereafter the description will refer primarily to two tiers. Three tiers are preferred however for rotors with a tip radius in excess of 450 mm [17½"] (e.g; for 1.2 m rotor).

The present invention recognises the difficulty in holding about a central region any large expanse of tungsten carbide or other carbide in place due to the centrifugal and impact forces.

In accordance with the present invention the centre unit (ie; the second member) provides a positive location of at least part of the annulus of tungsten carbide or the like of the outer ring (ie; the first member). This assists in the resistance of the centrifugal forces and such mechanical hold-down renders less important the bond (if any) between the substrate of such second member and its tungsten carbide or the like protective surface layer.

The present invention also recognises that with the mechanical separation of the parts being possible maintenance is rendered more easy. The first component is of a part hitherto available in more or less the same form as herein described from applicant for lesser diameter rotary mineral breakers.

Different parts of a composite distributor plate, depending on the wear pattern experienced in a particular machine, will require replacement ahead of others. There can of course also be the provision of different grades or harnesses of the wear resistant materials capping or providing the wear resistant surface of one or both of said first and second members to suit the differing conditions from the centre to the outer ring, ie; from the impact in the middle to the rubbing on the outside.

In one preferred form of the present invention the distributor plate "A" of the machines of Figures 1A and 1B are replaced at least for larger diameter rotor machines with an assembly as depicted in Figures 2 to 5.

In one preferred form of the present invention the second member 1 (see Figure 3A) is provided as a substrate of steel or steel alloy 2 and an annulus 3 of tungsten carbide which has been adhesively affixed to the substrate 2.

As shown in the embodiment in the drawings, component 1 includes a central

hole 4 surrounded by a recess 5 which will accommodate a head of a fixing bolt 6. It is that head of the bolt 6 which is provided with a female thread into which a bolt 7 for the second member 8 is to engage to locate the first component 8 over and to the second component 1. Of course a single through bolt could instead be used.

The member 8 itself is provided with a substrate 9 (preferably of a steel) and is provided with one or more pieces (preferably one) of tungsten carbide 10 which in a manner similar to that depicted in Figure 6 and, as previously described in relation to the second component, locates the tungsten carbide to the substrate 9. The member 8 however preferably has the configuration shown in Figures 4 and 5.

As can be seen from the drawings an effective distributor plate of a composite type form from two main members (each composite in themselves) provides a sufficient degree of contouring centrally notwithstanding the flatness of the tungsten carbide annulus 3 of the second member 1. This makes much easier the provision of large diameter distributor plates since only the relatively small central part thereof has any contouring of significance that makes fabrication more difficult.

The use of steel bolt/set screw 7 is in a low impact density area of the distributor and need not be, but can be, protected.

To ensure accuracy of fit and certainty of adhesion preferably an appropriate adhesive (eg; ESP110 Permabond™ of National Starch and Chemical Company) is used between the tungsten carbide and the substrate metal which preferably is an appropriate steel, for example, mild steel. Optionally the carbide can be in mould moulded into a substrate metal.

The most preferred form of the present invention (but for ease of explanation being described in respect of a three exit mineral breaker of the aforementioned BARMAC™ type) has a first component 11, a second component 17 and a capping member 12 which overlies a fixing bolt 16 adapted to associate the first member 11 into or through the base of the rotor.

As depicted each of the components 11, 12 and 17 is fabricated to include respectively wear resistant surfaces of adhered carbide 18, 13 and 19 respectively. In each instance preferably the substrate that supports such wear resistance surfacings is of an appropriate steel.

As shown in its assembled form in Figures 6 and 7, the preferential zones of wear appear on the flat annulus 19 at zones "W". Notches 20 in the perimeter of the substrate of the second member 12 enables different regions "W" to be presented, each area "W" being dictated by the relative positioning of the rotor exit relative to the second member wear resistant surface 19. Such periodic or regular turning of the free to rotate second component 19 relative to the still fixed first component 11 is preferably despite fixing bolt 16 being unloosened and still with its head 15 protected by the capping member 12 is assured.

As can be seen, the arrangement of Figures 6 through 8 is such that variously the capping member could be considered as a first component with respect to the component 11 just as the component 11 is a first component with respect to the second component 17.

Persons skilled in the art will appreciate therefore how a sequence of components can be provided to provide a compound wear resistant surface with the most simple shapes of the wear resistant surface (those of lesser 3-D detail [and indeed preferably flat as for 19]) more outwardly from the rotor axis.

In use "O" rings 22 can be utilised to locate the composite capping member 12 within the central recess of the first component 11 above the bolt head 15 with part of the wear resistant attachment to the capping member substrate 14 overlaying the top edge of the wear resistant layer 18 of the member 11. The wear resistant layer 18 in turn laps over the inner extremities of the wear resistant surface 19.

The present invention therefore envisages a simple fixing operation for component 11 utilising a bolt capable in turn of being protected by a push-in cap. When fixed relative to the rotor base the first member 11 holds captive and locates the second member 17 and its peripheral wear resistant surface 19 but still allowing its movement in order to maximise its life.

When the life of surface 19 is over member 17 it can readily be removed by release of the bolt 16 and the removal of the capping member to release the first component and in turn the second component. Such a surface 19 is cheap to replace owing to its generally planar nature.

Persons skilled in the art will appreciate how variations on the theme described

are possible but still are within the scope of the present invention. Whilst an option is to provide non rotation of the second component 17 persons skilled in the art will appreciate how maintenance down time is greatly reduced if that component is free to turn. To this end preferably a 1mm clearance gap is provided between the adjacent surfaces commencing at 21 between the member 11 and the member 17.

Persons skilled in the art will appreciate how only one small part of the overall product needs to be provided with a contoured protected surface with the majority of the composite product being provided with a simple flat, tungsten carbide or other shielding material. This therefore cheapens the cost of the provision of a replacement assembly or part thereof and should find widespread acceptance.

CLAIMS:

1. **A distributor assembly of the rotor of a rotary mineral breaker**, said rotor being of a kind adapted to receive under gravity substantially axially of the rotor mineral pieces to be broken and at least initiate the outward flow of such mineral pieces, said distributor assembly defining, with a first component, a wear resistant surface at least adjacent and about the rotor axis to receive in use at least some of said mineral pieces under gravity, and, with a second component, a wear resistant surface peripherally about at least said wear resistant surface of said first component,

wherein said first component defines a wear resistant surface that at least in part is steeper with respect to the horizontal than the wear resistant surface of said second component.

2. A distributor assembly of claim 1 wherein each said wear resistant surface is of a material affixed to and/or embedded in a substrate of that same component.

3. A distributor assembly of claim 1 or claim 2 wherein said wear resistant surface is defined by an appropriate carbide.

4. A distributor assembly as claimed in any one of the preceding claims wherein said second component defines a wear resistant surface greater in area when viewed in horizontal plan than the corresponding area of the wear resistant surface of said first component when also viewed in horizontal plan.

5. A distributor assembly as claimed in any one of the preceding claims wherein at least part of said second component underlies and is captured in use to said rotor by said first component.

6. A distributor assembly as claimed in claim 1 to 5 wherein fixing means locates said first component relative to the rotor and in use such location of the first component locates said second component.

7. A distributor assembly as claimed in claim 6 wherein said fixing means of said first component relative to the rotor is a rotor axis aligned bolt that engages into or through the rotor base.

8. A distributor assembly as claimed in claim 6 or 7 wherein said first component at least in part overlies part of said second component and at least in part is positioned within said second component so as to be capable of locating said second component

between said first component and the rotor base so as to present a wear resistant surface of said second component about a wear resistant surface of said first component.

9. A distributor assembly as claimed in claim 8 wherein said second component is capable of being rotated about the rotor axis without removal of said first component to thereby present different zones of the wear resistant surface of said second component as zones of preferential wear in use.

10. A distributor assembly as claimed in claim 9 wherein said fixing means is a bolt at the rotor axis engaged into or through the rotor base and the head of said bolt is in turn protected by a cap substantially centrally positioned with respect to said first component.

11. A distributor assembly as claimed in claim 10 wherein said cap is provided with a wear resistant surface and is at least in part received within a recess centrally of said first component above the head of said bolt.

12. A distributor assembly as claimed in claim 5 or claim 6 wherein there is in addition at least one further component itself defining a wear resistant surface to be positioned more peripherally than the wear resistant surface of said second component, at least one of said first or second components directly or indirectly providing a capturing or locating effect with respect to the rotor of the additional component or components.

13. A distributor assembly of any one of the preceding claims wherein the wear resistant surface of said second component is of substantially a simple horizontal annulus or a shallow rise frustoconical variant of such an annulus.

14. A distributor assembly as claimed in any one of the preceding claims wherein said first component is substantially of conical (which includes frustoconical), dome or bell shape in nature.

15. A distributor assembly as claimed in any one of the preceding claims wherein said wear resistant surface of said first component is symmetrical about the axis of the rotor.

16. A distributor assembly as claimed in any one of the preceding claims substantially as hereinbefore described with reference to any one or more of the accompanying drawings.

17. **A first component** for a distributor assembly as claimed in any one of the preceding claims.

18. **A second component** for a distributor assembly as claimed in any one of claims 1 to 17.

19. **In or for a rotary mineral breaker, a multi-tiered distributor plate** being a composite of at least

a first component in the rotor or capable of being positioned in the rotor so as to be surrounded at least in part by a second component, and

a said second component,

the arrangement being such that in use said first component assists in locating a mineral contacting part of said second component about the rotor axis.

20. Apparatus of claim 19 wherein said second component defines an annular or the like region about a central region, the central region being defined at least in part by said first component.

21. Apparatus as claimed in claim 19 or 20 wherein each of said first and second components is fabricated so as to be provided with a wear resistant surface.

22. Apparatus of any one of claims 19 to 21 wherein said first component at least in part overlies said second component.

23. Apparatus of any one of claims 19 to 22 which in use in the rotor of a rotary mineral breaker provides or will provide an assembly of any one of claims 1 to 16.

24. **A distributor plate** for a rotary mineral breaker comprising or including

a first component capable of being positioned at least in part over and at least in part within a second component, and

a said second component, the two components being capable in a rotor of defining a compound mineral distributing surface contour over at least part of the base of the rotor.

25. A distributor plate of claim 24 wherein said first component is capable of being fixed to the rotor at the rotor axis.

26. A distributor plate of claim 24 or 25 wherein each such component has been formed of a substrate material carrying a wear resistant material such that, in use, such wear resistant material defines said mineral distributing surface contour.

27. A distributor plate of any one of claims 24 to 26 which in use in the rotor of a rotary mineral breaker provides or will provide an assembly of any one of claims 1 to 16.

28. A distributor plate of any one of claims 19 to 27 wherein each of said first and second components has at least part of the surface thereof forming or to form part of said compound mineral distributing surface contour defined by an appropriate sacrificial material.

29. A distributor plate as claimed in claim 28 wherein said appropriate sacrificial material is a carbide.

30. A distributor plate as claimed in claim 29 wherein said appropriate carbide is tungsten carbide.

31. **A method of providing a compound mineral distributing surface contour in the base of the rotor of a rotary mineral breaker,** said method comprising or including

assembling by pre-assembly or sequential positioning within said rotor a first and second component of a kind as defined in any one or more of claims 1 to 16 and 19 (if sequentially positioned, said second component being placed first), and

thereafter attaching said first component to the rotor so as to capture both said second component and said first component to the rotor base.

32. **In or for a rotary mineral breaker, a composite distributor plate** being an assembly of two or more members, each of which members has a carbide wear resistant surface.

33. Apparatus of claim 32 fixed to the base of the rotor of such apparatus by one of said members only, at least one other such member being rotatably captured to the rotor by that member fixed to said rotor base.

34. A mineral distribution component substantially of a kind hereinbefore described with reference to any one or more of the accompanying drawings of or for a rotor of a rotary mineral breaker and which component forms or is to form part only of a mineral distributing surface of such a rotor over or as part of the base thereof.

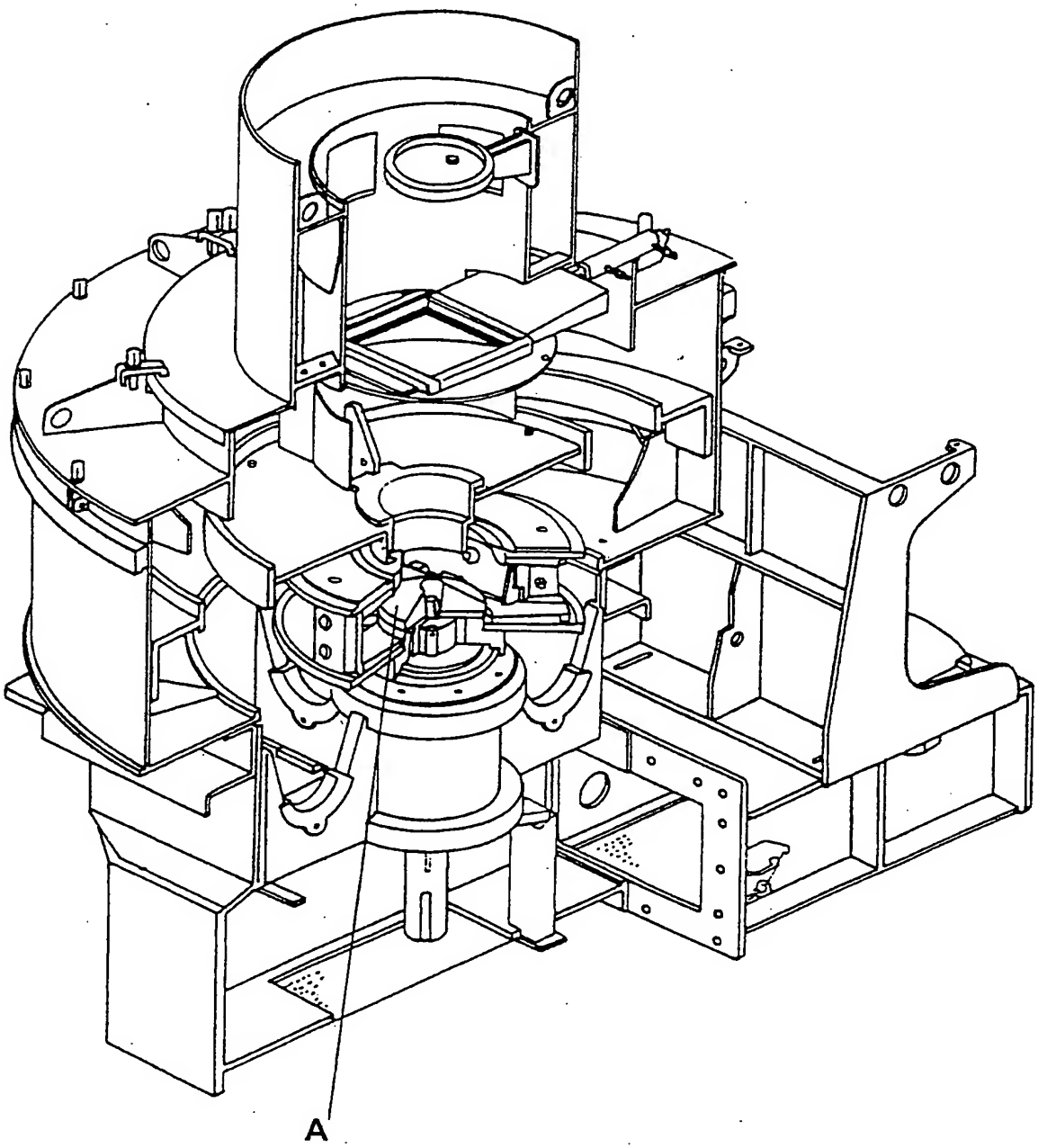

FIGURE 1A

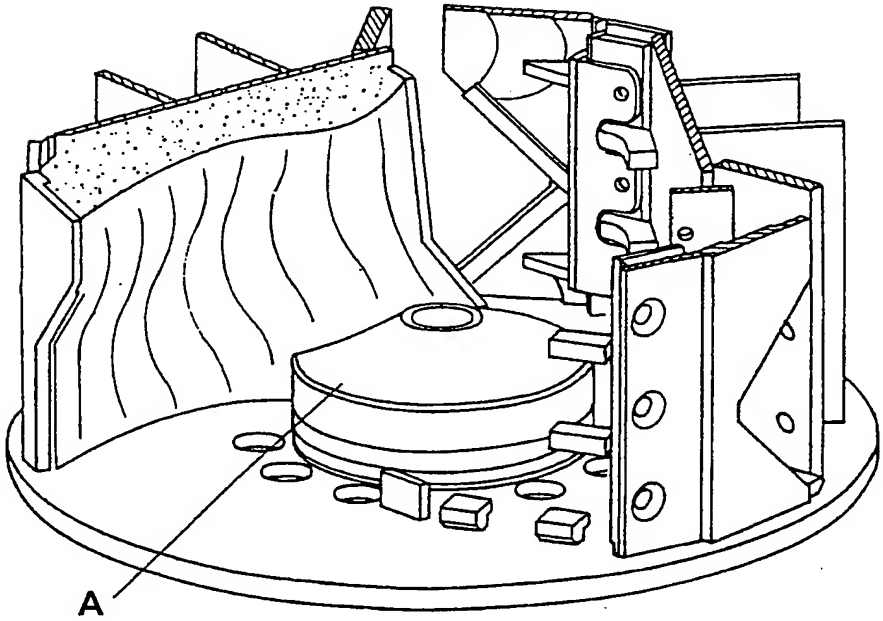

FIGURE 1B

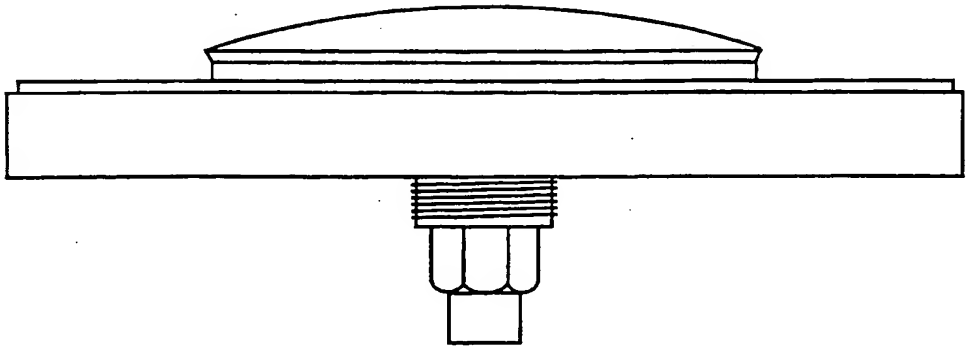

FIGURE 2

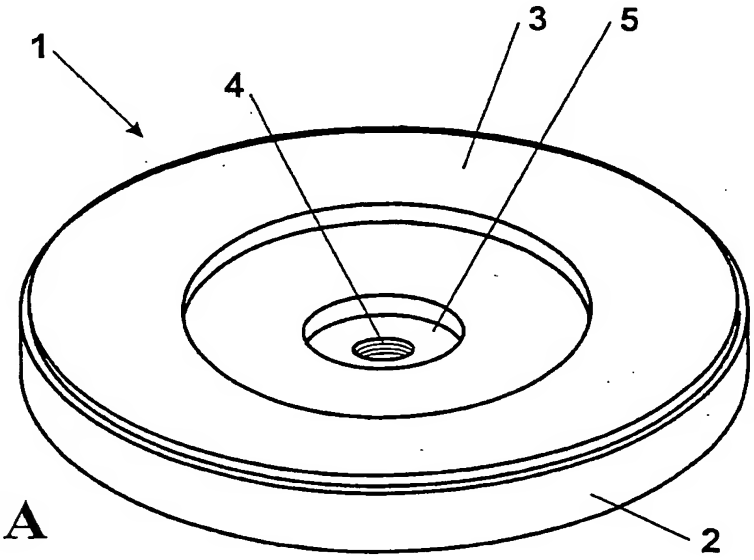

FIGURE 3A

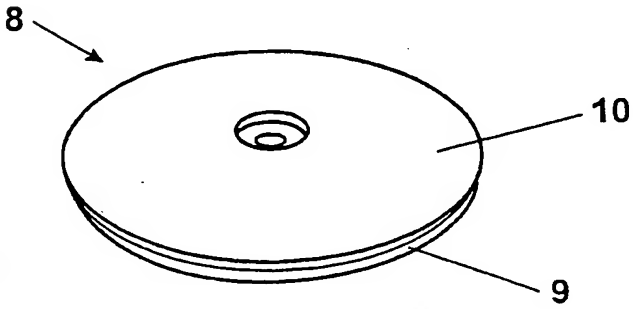

FIGURE 3B

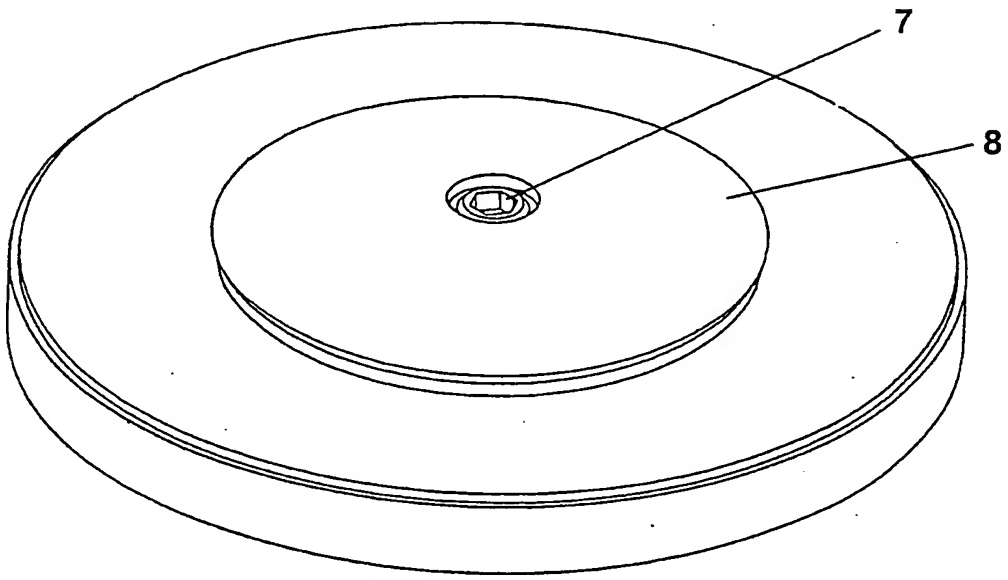

FIGURE 4

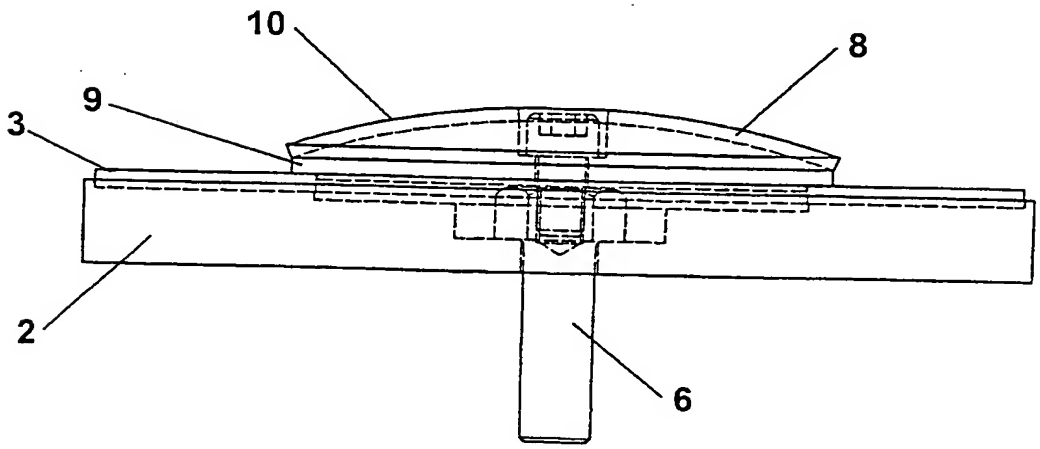

FIGURE 5

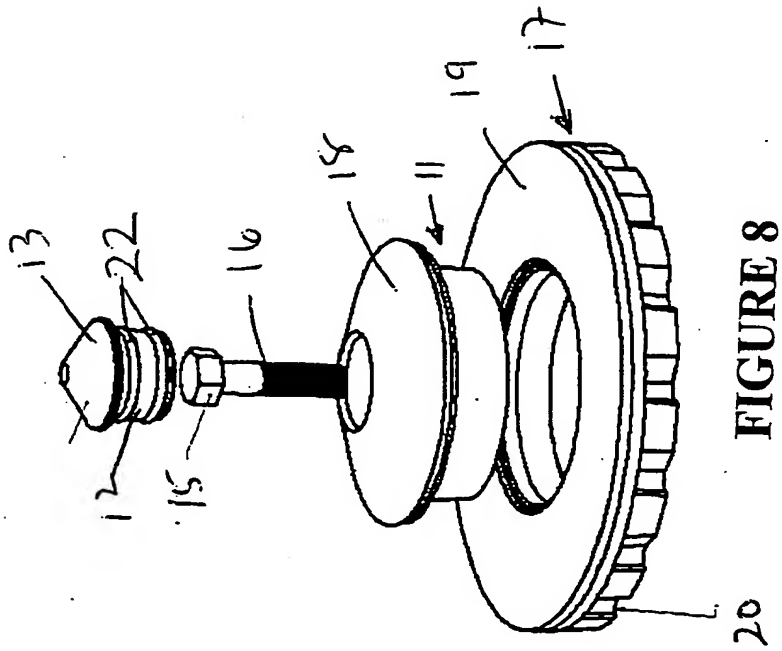

FIGURE 8

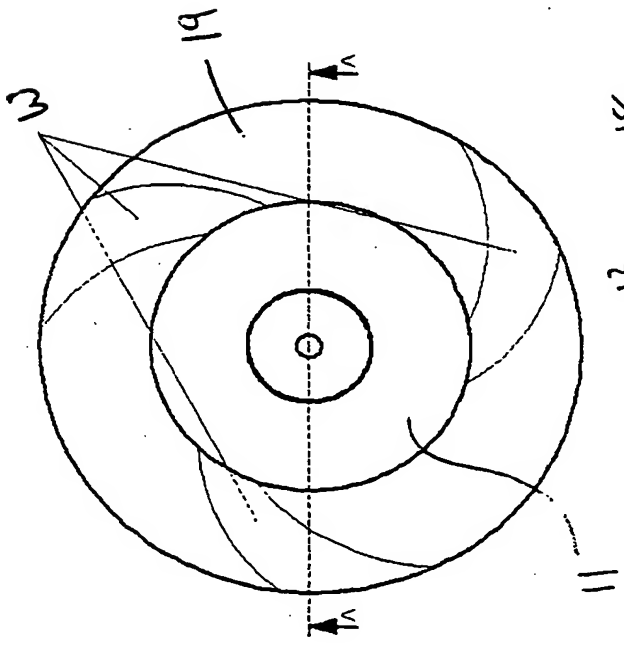

FIGURE 6

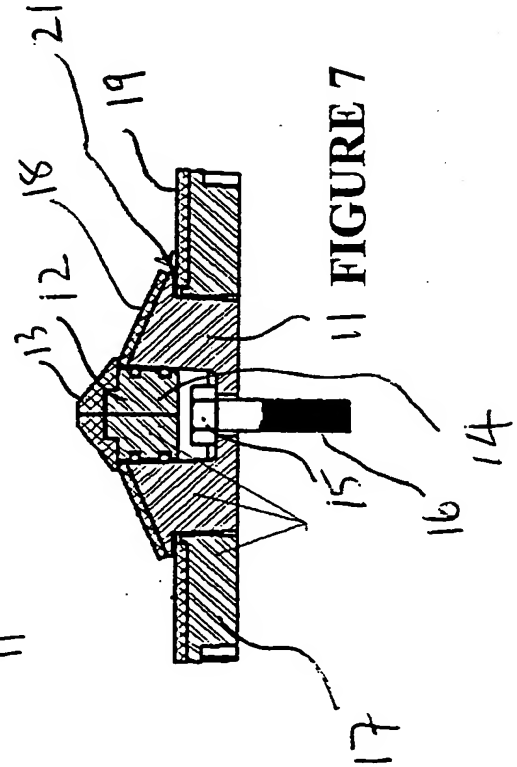

FIGURE 7